

WHAT IS CLAIMED IS:

1                   1. A method for determining which of a plurality  
2 of programs has been selected to be received by a monitored  
3 receiver, wherein each of the programs has an audio signal  
4 portion and is transmitted as a sequence of data packets in  
5 a corresponding channel, and wherein the monitored receiver  
6 has a receiver audio output representative of an audio  
7 signal portion of the selected program, the method  
8 comprising the following:

9                   a) comparing the receiver audio output with the  
10 audio signal portion of each of the programs until a match  
11 is found;

12                   b) reading an identifying code from one of the  
13 data packets associated with the matching program; and,

14                   c) storing the identifying code as a time-stamped  
15 record in a memory apparatus.

1                   2. The method of claim 1 wherein the receiver  
2 audio output comprises an audible acoustic signal, and  
3 wherein a) comprises the following:

4                   a1) acquiring, by way of a non-invasive sensor  
5 disposed adjacent the monitored receiver, the receiver audio  
6 output from the audible acoustic signal; and,

7                   a2) comparing the acquired receiver audio output  
8 with respective audio signal portions of each of the  
9 programs until a match is found.

1                   3. The method of claim 1 wherein a) comprises  
2 scanning the audio signal portions based on historical  
3 tuning of the monitored receiver.

1                   4. The method of claim 1 wherein a) comprises  
2 scanning the audio signal portions based on a list of  
3 favorite stations or channels or programs.

1                   5. The method of claim 1 wherein a) comprises  
2 scanning the audio signal portions based on intercepted  
3 remote control signals.

1                   6. The method of claim 1 wherein a) comprises  
2 scanning the audio signal portions based forecasts of the  
3 likelihood of tuning choices.

1                   7. The method of claim 1 wherein b) comprises the  
2 following:

3                   b1) demultiplexing a time-division multiplexed  
4 sequence of data packets in order to generate a transport  
5 bitstream associated with the program matching the receiver  
6 audio output; and,

7                   b2) reading the identifying code from the  
8 transport bitstream.

1                   8. The method of claim 1 wherein a) comprises the  
2 following:

3                   a1) selecting a channel or source;

4                   a2) digitizing the receiver audio output;

5                   a3) applying a first transform to the digitized  
6 receiver audio output in order to obtain a receiver audio  
7 output spectrum;

8                   a4) applying a second transform to the audio  
9 signal portion of one of the plurality of the programs in

10 the selected channel or source in order to generate a  
11 corresponding audio signal portion spectrum;

12 a5) comparing the receiver audio output spectrum  
13 and the audio signal portion spectrum to thereby generate a  
14 single aggregate matching score;

15 a6) if the score exceeds a predetermined value,  
16 deciding that the match has been found; and,

17 a7) if the score does not exceed the predetermined  
18 value, selecting a different one of the plurality of  
19 programs and repeating a4) through a7), as necessary.

1 9. The method of claim 8 wherein a) further  
2 comprises returning to a1) if a6) and a7) do not result in a  
3 match.

1 10. The method of claim 8 wherein the first and  
2 second transforms are the same transforms.

1 11. The method of claim 10 wherein each of the  
2 first and second transforms is a Modified Discrete Cosine  
3 Transform.

1                   12. The method of claim 10 wherein each of the  
2 first and second transforms is a Fast Fourier Transform.

1                   13. The method of claim 8 wherein a5) comprises  
2 comparing the receiver audio output spectrum and the audio  
3 signal portion spectrum at each of a plurality of  
4 frequencies.

1                   14. The method of claim 8 wherein at least one of  
2 the first and second transforms is derived from less than  
3 400 ms of a corresponding signal.

1                   15. The method of claim 1 wherein a) comprises  
2 the following:

3                   a1) digitizing at least a portion of the receiver  
4 audio output; and,

5                   a2) extracting a feature set from the digitized  
6 portion, wherein the digitized portion is at least as long  
7 as is needed for the feature set plus a delay introduced by  
8 the monitored receiver.

1                   16. The method of claim 1 wherein a) comprises  
2                   comparing the receiver audio output with the audio signal  
3                   portion to produce a same output when the receiver audio  
4                   output and the audio signal portion match, a difference  
5                   output when the receiver audio output and the audio signal  
6                   portion do not match, a noise output when at least one of  
7                   the receiver audio output and the audio signal portion is  
8                   noisy, and a silent output when at least one of the receiver  
9                   audio output and the audio signal portion is silent.

1                   17. The method of claim 16 wherein a) comprises  
2                   counting silent and noisy blocks of at least one of the  
3                   receiver audio output and the audio signal portion.

1                   18. The method of claim 16 wherein a) comprises  
2                   transitioning between search, verification, wait-to-see, and  
3                   audio-off states.

1                   19. The method of claim 1 wherein a) comprises  
2                   comparing weighted slopes of the receiver audio output with  
3                   weighted slopes of the audio signal portion.

1                   20. The method of claim 1 wherein a) comprises  
2                   transitioning between search, verification, wait-to-see, and  
3                   audio-off states.

1                   21. An apparatus for identifying a program  
2                   selected for reception on a monitored receiver having an  
3                   audio output, wherein the selected program comprises one of  
4                   a plurality of receivable programs, wherein each of the  
5                   plurality of receivable programs is distributed as a time-  
6                   division sequence of data packets at a corresponding one of  
7                   a plurality of radio frequencies, the apparatus comprising:  
8                   a tuner and demodulator arranged to receive a  
9                   predetermined one of the receivable programs;  
10                  a first feature extractor arranged to extract a  
11                  first set of characteristic features from the audio output;  
12                  a second feature extractor arranged to extract a  
13                  second set of characteristic features from the predetermined  
14                  program;  
15                  a comparator arranged to compare the first and the  
16                  second sets of characteristic features and to determine if  
17                  the first and the second sets of characteristic features  
18                  match;

19                   a code extractor arranged to extract a program  
20                   identifying code from the predetermined program.

1                   22. The apparatus of claim 21 wherein the  
2                   comparator comprises a microprocessor.

1                   23. The apparatus of claim 21 further comprising  
2                   a microphone disposed adjacent the monitored receiver,  
3                   wherein the microphone is arranged to acquire the audio  
4                   output of the monitored receiver.

1                   24. The apparatus of claim 21 further comprising  
2                   a coupling to an audio output connector of the monitored  
3                   receiver, wherein the coupling is arranged to acquire the  
4                   audio output of the monitored receiver.

1                   25. The apparatus of claim 21 wherein the tuner  
2                   and demodulator includes a scanning tuner arranged to scan  
3                   through the plurality of programs and to provided the  
4                   scanned programs to the second feature extractor.



1                   26. The apparatus of claim 25 wherein the  
2 scanning tuner is arranged to scan through the plurality of  
3 programs based on historical tuning of the monitored  
4 receiver.

1                   27. The apparatus of claim 25 wherein the  
2 scanning tuner is arranged to scan through the plurality of  
3 programs based on a list of favorite stations or channels or  
4 programs.

1                   28. The apparatus of claim 25 wherein the  
2 scanning tuner is arranged to scan through the plurality of  
3 programs based on an intercepted remote control signal.

1                   29. The apparatus of claim 25 wherein the  
2 scanning tuner is arranged to scan through the plurality of  
3 programs based on forecasts of the likelihood of tuning  
4 choices.

1           30. The apparatus of claim 21 wherein the second  
2 feature extractor is arranged to demultiplex a time-division  
3 multiplexed sequence of data packets in order to generate a  
4 transport bitstream associated with the program matching the  
5 receiver audio output, and wherein code extractor is  
6 arranged to extract a program identifying code from the  
7 transport bitstream.

1           31. The apparatus of claim 21 wherein:  
2           the first feature extractor is arranged to  
3 digitize the audio output and to apply a first transform to  
4 the digitized audio output in order to obtain a receiver  
5 audio output spectrum;  
6           the second feature extractor is arranged to apply  
7 a second transform to audio signal portions of each of the  
8 programs in order to generate a program spectrum;  
9           the comparator is arranged to compare the receiver  
10 audio output spectrum and the program spectrum to thereby  
11 generate a single aggregate matching score;  
12           if the score exceeds a predetermined value, the  
13 comparator is arranged to decide that the match has been  
14 found; and,

15                   if the score does not exceed the predetermined  
16 value, the comparator is arranged to select a different one  
17 of the programs and to repeat the comparison of the receiver  
18 audio output spectrum and the program spectrum, as  
.9 necessary.

1                   32. The apparatus of claim 31 wherein the first  
2 and second transforms are the same transform.

1                   33. The apparatus of claim 32 wherein each of the  
2 first and second transforms is a Modified Discrete Cosine  
3 Transform.

1                   34. The apparatus of claim 32 wherein each of the  
2 first and second transforms is a Fast Fourier Transform.

1                   35. The apparatus of claim 31 wherein the  
2 comparator is arranged to compare the receiver audio output  
3 spectrum and the program spectrum at each of a plurality of  
4 frequencies.

1           36. The apparatus of claim 31 wherein at least  
2 one of the first and second transforms is derived from less  
3 than a predetermined time of a corresponding signal.

1           37. The apparatus of claim 21 further comprising  
2 a memory arranged to store the program identifying code as a  
3 time-stamped record.

1           38. The apparatus of claim 21 wherein the code  
2 extractor is arranged to extract the program identifying  
3 code only if the first and the second sets of characteristic  
4 features match.

1           39. The apparatus of claim 21 wherein the first  
2 feature extractor is arranged to digitize at least a portion  
3 of the receiver audio output and to extract a feature set  
4 from the digitized portion, wherein the digitized portion is  
5 at least as long as is needed for the feature set plus a  
6 delay introduced by the monitored receiver.

1           40. The apparatus of claim 21 wherein the  
2       comparator is arranged to compare the first and second sets  
3       of characteristic features so as to produce a same output  
4       when the first and second sets of characteristic features  
5       match, a difference output when the first and second sets of  
6       characteristic features do not match, a noise output when at  
7       least one of the first and second sets of characteristic  
8       features is noisy, and a silent output when at least one of  
9       the first and second sets of characteristic features is  
10      silent.

1           41. The apparatus of claim 40 wherein the  
2       comparator comprises silent and noisy blocks counters for at  
3       least one of the first and second sets of characteristic  
4       features.

1           42. The apparatus of claim 40 wherein the  
2       comparator transitions between search, verification, wait-  
3       to-see, and audio-off states.

1                   43. The apparatus of claim 21 wherein the  
2                   comparator compares weighted slopes of the first and second  
3                   sets of characteristic features.

1                   44. The apparatus of claim 21 wherein the  
2                   comparator transitions between search, verification, wait-  
3                   to-see, and audio-off states.

1                   45. A method for determining which of a plurality  
2                   of programs has been selected to be received by a monitored  
3                   receiver, wherein each of the programs is transmitted as a  
4                   sequence of data packets in a corresponding channel, and  
5                   wherein the monitored receiver has a receiver output  
6                   representative of the selected program, the method  
7                   comprising the following:

8                   a) comparing the receiver output with each of the  
9                   plurality of programs until a match is found; and,

10                   b) reading an identifying code from one of the  
11                   data packets associated with the matching program.

1                   46. The method of claim 45 wherein a) comprises  
2 the following:

3                   a1) acquiring, by way of a non-invasive sensor  
4 disposed adjacent the monitored receiver, the receiver  
5 output; and,

6                   a2) comparing the acquired receiver output with  
7 each of the plurality of programs until a match is found.

1                   47. The method of claim 45 wherein a) comprises  
2 scanning the plurality of programs based on historical  
3 tuning of the monitored receiver.

1                   48. The method of claim 45 wherein a) comprises  
2 scanning the plurality of programs based on a list of  
3 favorite stations or channels or programs.

1                   49. The method of claim 45 wherein a) comprises  
2 scanning the plurality of programs based on intercepted  
3 remote control signals.

1                   50. The method of claim 45 wherein a) comprises  
2 scanning the plurality of programs based on forecasts of the  
3 likelihood of tuning choices.

1                   51. The method of claim 45 wherein a) comprises  
2 the following:

3                   a1) applying a first transform to the receiver  
4 output in order to obtain a receiver output spectrum;

5                   a2) applying a second transform to one of the  
6 plurality of the programs in order to generate a  
7 corresponding signal portion spectrum;

8                   a3) comparing the receiver output spectrum and the  
9 signal portion spectrum to thereby generate a score;

10                  a4) if the score exceeds a predetermined value,  
11 deciding that a match has been found; and,

12                  a5) if the score does not exceed the predetermined  
13 value, deciding that a match has not been found, selecting a  
14 next one of the plurality of programs and repeating at least  
15 a2) through a5).

1                   52. The method of claim 51 wherein the first and  
2 second transforms are the same transform.



1                   53. The method of claim 52 wherein each of the  
2 first and second transforms is Modified Discrete Cosine  
3 Transform.

1                   54. The method of claim 52 wherein each of the  
2 first and second transforms is a Fast Fourier Transform.

1                   55. A method for determining which of a plurality  
2 of programs has been tuned by a monitored receiver, wherein  
3 each of the programs is transmitted as a sequence of data  
4 packets in a corresponding channel, and wherein the  
5 monitored receiver has a receiver output representative of  
6 the selected program, the method comprising the following:

7                   a) determining a test power spectrum based upon  
8 the receiver output;

9                   b) determining a plurality of reference power  
10 spectra based upon the plurality of programs;

11                   c) comparing the test power spectrum with each of  
12 the reference power spectra, as necessary, to determine a  
13 match; and,

14                   d) determining an identification indicia based  
15                   upon the match.

1                   56. The method of claim 55 wherein a) comprises  
2                   applying a first transform to the receiver output in order  
3                   to obtain the test power spectrum, and wherein b) comprises  
4                   applying a second transform to the plurality of programs in  
5                   order to generate the plurality of reference power spectra.

1                   57. The method of claim 56 wherein the first and  
2                   second transforms are the same transform.

1                   58. The method of claim 57 wherein each of the  
2                   first and second transforms is a Modified Discrete Cosine  
3                   Transform.

1                   59. The method of claim 57 wherein each of the  
2                   first and second transforms is a Fast Fourier Transform.

1                   60. The method of claim 55 wherein the  
2                   identification indicia is a channel to which the monitored  
3                   receiver is tuned.

1                   61. The method of claim 55 wherein the  
2                   identification indicia is a program label associated with a  
3                   program to which the monitored receiver is tuned.

1                   62. The method of claim 55 wherein the  
2                   identification indicia is a station associated with a  
3                   channel to which the monitored receiver is tuned.

1                   63. The method of claim 55 wherein a) comprises  
2                   determining n test power spectra based upon n sample blocks  
3                   of the receiver output, wherein b) comprises determining n  
4                   reference power spectra based upon one of the plurality of  
5                   programs, wherein c) comprises comparing the n test power  
6                   spectra with the n reference power spectra to form a single  
7                   match score, and wherein d) comprises determining an  
8                   identification indicia based upon the single match score.

1                   64. The method of claim 55 wherein a) comprises  
2           determining  $n + m$  test power spectra based upon  $n + m$  sample  
3           blocks of the receiver output, wherein b) comprises  
4           determining  $n$  reference power spectra based upon one of the  
5           plurality of programs, wherein c) comprises comparing the  $n$   
6           +  $m$  test power spectra with the  $n$  reference power spectra to  
7           form a single match score, and wherein d) comprises  
8           determining an identification indicia based upon the single  
9           match score.